This document includes Section 10.0 – WPB 110 Class: Vessels with Compression Ignition Engines, Landing Craft, Coastal Mine Hunters, and Buoy Tenders, of the Draft EPA Report "Surface Vessel Bilgewater/Oil Water Separator Environmental Effects Analysis Report" published in 2003. The reference number is: EPA-842-D-06-018

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Section 10.0 – WPB 110 Class: Vessels with Compression Ignition Engines, Landing Craft, Coastal Mine Hunters, and Buoy Tenders

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SECTION 10.0 – WPB 110 CLASS

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10.0 WPB 110 CLASS

10.1 INTRODUCTION

This Environmental Effects Analysis Report (EEAR) presents surface vessel bilgewater discharge from the Uniform National Discharge Standards (UNDS) vessel group, "Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement)." The Coast Guard ISLAND Class (WPB 110) was chosen as the representative vessel class for this group because it is one of the newest and largest vessel classes (49 hulls), and is distributed along the Pacific, Atlantic, and Gulf coasts. New vessels in construction in this class include the Coast Guard 87 ft MARINE PROTECTOR Class, which has the last hull scheduled to be delivered by FY 2003. For more information about the vessel group and the selection of the representative vessel class used in this environmental effects analysis (EEA), see *Vessel Grouping and Representative Vessel Class Selection for Surface Vessel Bilgewater/Oil-Water Separator Discharge* (Navy and EPA, 2001d).

Ships in this vessel group receive fluids in the bilge mainly from condensation that forms on the interior hull and on piping, and from leaking pump packing glands, piping, valves, and flanges. The bilgewater of these ships may have oily constituents from diesel fuel marine (DFM) used for main engines and generators and lubricants such as 9250 lube oil (main engines and generators), 2190TEP lube oil (auxiliary equipment), hydraulic oil (elevators, cranes, and winches), and various grades of grease lubricants, used on pulleys, cables, valves, and other components.

Bilgewater discharges from the WPB 110 were characterized using surrogate data and supplemented by process knowledge from equipment experts and vessel drawings. During UNDS Phase II, sampling was conducted aboard two vessels of the LSD 41 class, USS OAK HILL, and USS RUSHMORE, on November 16-17, 1999 and September 26, October 17, November 17 and December 13, 2000. These two sampling episodes provided surrogate data for the WPB 110 vessel group. Examples of sample data and process knowledge include end-of-pipe (EOP) chemical constituent concentrations, suspended solids and oil and grease (hexane extractable material (HEM)) concentrations, field measurements of pH, flow rates, and descriptive information such as color and odor. The Navy analyzed samples for constituent concentration from the wastestream before processing (i.e., baseline discharge) and after marine pollution control device (MPCD) treatment. Details on the characterization of this discharge are contained in the *Characterization Analysis Report: Surface Vessel Bilgewater/OWS Discharge* (hereafter referred to as the Bilgewater Characterization Analysis Report (ChAR)) (Navy and EPA, 2003).

10.2 DIFFERENCES FROM THE EEA METHODOLOGY

The analysis of discharge information and presentation of results in this report are in accordance with the methodology contained in *Environmental Effects Analysis Guidance for Phase II of the Uniform National Discharge Standards for Vessels of the Armed Forces* (Navy and EPA, 2000e, hereafter referred to as the EEA guidance manual). The EEA for surface vessel bilgewater/OWS discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons

of displacement) did not require any variation from the methodology contained in the EEA guidance manual.

10.3 SUMMARY OF EEA RESULTS

This section summarizes the results of the eight technical tasks conducted for the baseline discharge and each MPCD discharge.

10.3.1 Baseline Discharge

The baseline discharge has been subjected to a full EEA as a basis for comparing MPCD options; however, this vessel group does not release the untreated baseline discharge into the receiving waters. Currently, a gravity-coalescence OWS system processes bilgewater produced by this vessel group (see Section 10.3.2) prior to overboard discharge.

10.3.1.1 Discharge Characterization Data

Baseline discharge characterization data for Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) were assembled from surrogate data and supplemented by process knowledge from equipment experts and vessel drawings. The surrogate data for this vessel group were taken from the LSD 41 Class. The Bilgewater ChAR (Navy and EPA, 2003) contains more information on the collection and analyses of discharge characterization data.

The data analysis for this discharge identified 15 constituents of concern (COCs), two classes of constituents (i.e., a group of constituents such as total aromatic hydrocarbons), and eight narrative categories in the baseline discharge. In accordance with the EEA guidance manual (Navy and EPA 2000e), COCs are defined as:

- Constituents that exceed one or more numeric water quality criteria (WQC) at EOP or any narrative WQC;
- Constituents identified as bioaccumulative contaminants of concern (BCCs); or
- Constituents with EOP hazard quotients (HQ) > 1.

Appendix B lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at the edge of the mixing zone (EOMZ), and indicates whether they are elimination or reduction BCCs.

10.3.1.2 Discharge Comparison to Criteria

The composition of bilgewater is characterized by a set of constituent concentrations compiled from surrogate data, as described in the Bilgewater ChAR (Navy and EPA, 2003). In the comparison of constituent data for baseline discharge to numeric WQC (WQC), the EOP concentrations of 14 constituents or constituent classes exceeded 96 WQC (Table 10-1). Appendix A summarizes the comparison of the COC concentrations to corresponding Federal

and State WQC. The baseline discharge also exceeded eight narrative WQC categories (Table 10-2). Appendix C provides the complete narrative WQC analysis.

Table 10-1. Constituents Exceeding Numeric Water Quality Criteria Identified in the Baseline Discharge[1] from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data

Constituents	Concentration at EOP (μg/L)	Criteria Exceeded	Strictest Criterion (μg/L)	State(s) with Strictest Criterion
Saltwater:				
Copper	1.3E+01	22 of 24	2.4E+00	CT, GA, MS
Iron	3.4E+02	1 of 1	3.0E+02	FL
Lead	8.9E+00	1 of 11	5.6E+00	FL
Manganese	1.1E+02	1 of 1	1.0E+02	PR
Nickel	1.1E+02	22 of 24	8.3E+00	FL, NC, PR
Thallium	1.5E+01	1 of 7	6.3E+00	FL
Zinc	4.1E+02	22 of 24	5.0E+01	PR
Phenanthrene	1.1E+01	3 of 3	5.0E+00	PA
Total Aqueous Hydrocarbons	7.4E+01	1 of 1	1.5E+01	AK
Total Aromatic Hydrocarbons	2.4E+01	1 of 1	1.0E+01	AK
Ammonia as Nitrogen	1.2E+03	1 of 2	2.3E+02	WA
Freshwater:				
Cadmium	2.3E+00	1 of 8	1.1E+00	FD
Copper	1.3E+01	12 of 14	8.8E+00	GA
Zinc	9.8E+01	7 of 14	6.4E+01	GA

[1] *Baseline discharge from this vessel group is not discharged overboard. Discharge occurs only after the bilgewater is treated by a gravity coalescence OWS.*

Table 10-2. Narrative Water Quality Criteria Categories Exceeded by the Baseline Discharge[1] from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Narrative Constituent with Applicable Numeric Endpoint	Result
Saltwater:	
Color	Fail
Nutrients	Fail
Total Nitrogen (3.0E+02 μg/L)	3.0E+03 μg/L
Phosphorus (6.0E+01 μg/L)	2.3E+02 μg/L
Ammonia (1.0E+01 μg/L)	1.2E+03 μg/L
Nitrate/Nitrite (1.5E+01 μg/L)	3.0E+03 μg/L
Odor	Fail
Oil and Grease (HEM)	Fail
EOP HEM (5.0E+03 μg/L)	2.7E+04 μg/L
No Sheen (1.5E+04 μg/L EOP)	2.7E+04 μg/L
Turbidity/Colloidal Matter	Fail

Narrative Constituent with Applicable Numeric Endpoint	Result
Freshwater:	
Hardness	Fail
Nutrients	Fail
Total Phosphorus (5.0E+01 μg/L)	2.3E+02 μg/L
Oil and Grease (HEM)	Fail
EOP HEM (1.0E+02 μg/L)	2.7E+04 μg/L
No Sheen (1.5E+04 μg/L EOP)	2.7E+04 μg/L

[1] *Baseline discharge from this vessel group is not discharged overboard. Discharge occurs only after the bilgewater is treated by a gravity coalescence OWS.*

10.3.1.3 Discharge Toxicity (Hazard Index)

Based on curvilinear-grid hydrodynamic 3D (CH3D) model results, the minimum dilution factor at the EOMZ for the baseline discharge was estimated to be 4795. This dilution factor was applied to the EOP concentration of the constituents to determine discharge toxicity at the EOMZ. The input parameters for this model run are presented in Appendix D, and the dilution graph, indicating the minimum dilution factor, is presented in Appendix E. For more information about the UNDS modeling method, see the *Technical Approach for Pierside Modeling to Support UNDS EEA Phase II* (Navy and EPA, 2001e).

Table 10-3 summarizes the results of the HQ and hazard index (HI) calculations for the baseline discharge constituents with an EOP HQ greater than 1. For more information on the use of the HI calculations in the UNDS program, see *Method for Assessing the Toxicity of Multiple Contaminants in Discharges from Vessels of the Armed Forces Uniform National Discharge Standards (UNDS) Phase II* (Navy and EPA 2001f). The constituents are listed from highest to lowest HQ at EOMZ.

Table 10-3. Constituents with Hazard Quotients >1 at End of Pipe, Ranked by Edge of Mixing Zone Hazard Quotient, in the Baseline Discharge[1] from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Constituents	HQ at EOMZ
Total Sulfide	3.3E-02
Nitrate/Nitrite	8.8E-03
Copper	8.7E-03
Oil and Grease (HEM[2])	6.8E-03
Sulfate	3.3E-03
Zinc	9.5E-04
Thallium	5.1E-04
Nickel	3.2E-04
Iron	2.4E-04
Manganese	2.2E-04

HI of above constituents	6.3E-02
Total Discharge HI	6.3E-02

[1] *Baseline discharge from this vessel group is not discharged overboard. Discharge occurs only after the bilgewater has been treated by a gravity coalescence OWS.*

[2] *HEM TEC value was based on the fuel/lube TEC. For more information, see* Development of TECs for Categories Derived from Petroleum and Foods *(Navy and EPA, 2001g)*

The discharge HI at EOMZ is approximately 0.063, with the above constituents comprising approximately 99 percent of the total discharge HI.

An HI of 1.0 or less is the level considered to be protective of aquatic life from acute toxic effects of the discharge. This level is equivalent to the United States Environmental Protection Agency (EPA) WQC for aquatic life [i.e., Criterion Maximum Concentration (CMC)]. The CMC is intended to protect most species most of the time (EPA, 1991). This level of protection is set near the concentration resulting in no observable effect on the most sensitive aquatic species, which EPA has determined will adequately protect aquatic communities. At HI values less than or equal to 1.0, the potential for acute toxic effects to aquatic species is considered to be at an acceptable level.

10.3.1.4 Non-Indigenous Species Release

The potential for the baseline discharge to introduce non-indigenous species (NIS) is expected to be low because *"there is only minor seawater access to bilge compartments, and bilgewater is generally processed before it is transported over long distances"* (EPA and DoD, 1999).

10.3.1.5 Bioaccumulative Contaminants of Concern

Table 10-4 lists the EOP concentrations of the seven constituents from the baseline discharge identified as elimination and reduction BCCs. BCCs for the UNDS program are divided into two types: those designated for elimination by various international, Federal, and State programs, and those designated for reduction by United States permit and cleanup programs.

Table 10-4. Bioaccumulative Contaminants of Concern Identified in the Baseline Discharge[1] from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Elimination BCCs (µg/L)		Reduction BCCs (µg/L)	
Lead	8.9E+00	Zinc	4.1E+02
Cadmium	2.3E+00	Copper	2.0E+02
		Naphthalene	1.3E+01
		Phenanthrene	1.1E+01
		Selenium	7.2E+00

[1] *Baseline discharge from this vessel group is not discharged overboard. Discharge occurs only after the bilgewater is treated with a gravity coalescence OWS.*

10.3.1.6 Constituent Mass Loading and Toxic Pound Equivalents

Determination of discharge constituent mass loading and toxic pound equivalent (TPE) values are based on discharge generation volume and location of vessel operation. The WPB 110 (representative vessel class) is pierside approximately 127 days per year, 200 days per year transiting inside 12 nm, and 28 days per year operating underway outside 12 nm (Navy and EPA, 2003).

Table 10-5 presents mass loading and TPEs for the COCs identified in the baseline discharge for the active vessels in this vessel group while operating inside 12 nm. The COCs are listed from highest to lowest TPE and comprise 99 percent of the total discharge TPE of both saltwater and freshwater. Appendix F presents the complete discharge constituent mass loading and TPE data.

TPE results presented in Table 10-5 do not include the chronic toxicity contribution from oil and grease (HEM) constituents, because there are insufficient data available to develop a defensible toxic weighting factor (TWF) for oil and grease (HEM). The chronic toxicity contributions from oil and grease (HEM) constituents could potentially be estimated by extrapolation of HQ and HI results (refer to Section 10.3.1.3). The HI calculations indicate that oil and grease (HEM) constituents contribute approximately 11 percent of the total discharge HI, a measure of the total acute toxicity of bilgewater. Therefore, oil and grease (HEM) constituents are assumed to contribute approximately 11 percent of the total chronic toxicity for this analysis.

Table 10-5. Mass Loading and Toxic Pound Equivalents for the Constituents of Concern Identified in the Baseline Discharge[1] from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Saltwater:		
Total Sulfide	4.7E+01	1.3E+02
Copper	3.1E+00	5.6E+00
Nitrate/Nitrite	4.6E+01	4.3E+00
Nickel	1.8E+00	1.2E+00
Manganese	1.7E+00	1.0E+00
Zinc	6.4E+00	4.4E-01
Thallium	2.4E-01	2.1E-01
Ammonia as Nitrogen	1.9E+01	1.6E-01
Lead	1.4E-01	9.6E-02
Phenanthrene	1.8E-01	9.0E-02
Sulfate	7.8E+03	4.4E-02
Cadmium	3.6E-02	2.4E-02
Naphthalene	2.1E-01	9.6E-03
Iron	5.3E+00	9.0E-03
Selenium	1.1E-01	8.9E-03
COC TPE Total		**1.5E+02**
Total Discharge TPE		**1.5E+02**

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Freshwater:		
Total Sulfide	4.7E+00	1.3E+01
Nitrate/Nitrite	4.5E+00	4.2E-01
Copper	3.1E-01	1.9E-01
Lead	1.4E-02	3.1E-02
Zinc	6.3E-01	3.0E-02
Thallium	2.4E-02	2.4E-02
Nickel	1.7E-01	1.9E-02
Manganese	1.6E-01	1.2E-02
Selenium	1.1E-02	1.2E-02
Cadmium	3.6E-03	9.4E-03
Phenanthrene	1.7E-02	5.1E-03
Sulfate	7.7E+02	4.3E-03
Iron	5.2E-01	2.9E-03
Naphthalene	2.0E-02	3.1E-04
COC TPE Total		**1.4E+01**
Total Discharge TPE		**1.4E+01**

[1] *Baseline discharge from this vessel group is not discharged overboard. Discharge occurs only after the bilgewater is treated by a gravity coalescence OWS.*

10.3.1.7 Other Potential Environmental Impacts

Currently, all vessels in this group process bilgewater through a gravity coalescence OWS system before discharge. The environmental effects from the use of the gravity coalescence OWS are discussed in Section 10.3.2 below.

If CHT is employed, the baseline discharge is held onboard and then transferred to a shore facility for recycling or disposal without passing through an OWS system. The offloaded bilgewater is then treated at a properly permitted facility and is subject to applicable Federal, State, and local disposal regulations.

10.3.1.8 Summary of Environmental Effects

The analysis of the baseline discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) identified 15 COCs, two constituent classes, and eight narrative categories. Appendix B lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at EOMZ, and indicates whether they are elimination or reduction BCCs. Appendix F presents the annual mass loading and TPE data for this discharge.

In summary, the baseline discharge:

- Exceeds 96 numeric WQC and eight narrative criteria categories;
- Has an EOMZ HI of 0.063;

- Has low potential to introduce NIS;
- Contains two elimination and five reduction BCCs; and
- Has a saltwater total discharge TPE inside 12 nm of 150, with the COCs comprising approximately 99 percent of the total and a freshwater total discharge TPE inside 12 nm of 14, with the COCs comprising approximately 99 percent.

10.3.2 Primary Treatment MPCD

For purposes of bilgewater analysis, gravity coalescence type oil water separators (OWSs) represent the three primary MPCD options determined to be feasible aboard the WPB 110 Class vessels (refer to Section 10.1).

As described in Navy and EPA (2000b), gravity coalescence type OWSs operate on the principle that due to the immiscibility and specific gravity differences of oil and water, the oil will separate from the water and droplets will coalesce into a separate layer of fluid. Oily waste is pumped from the oily waste holding tank (OWHT) through the OWS, which contains coalescing material. Coalescing material is typically polypropylene, an oleophilic polymer that may be in the form of parallel plates or loose packed media. As the oil droplets, entrained in the influent, flow through the OWS, they will come into contact with the coalescing material and adhere to it. As more droplets attach to the polymer, they will come in contact with each other and form larger droplets (coalesce). These droplets will break free from the plates or media and rise to the surface of the OWS tank where they typically collect in an oil tower. The OWS has sensors that detect the presence of oil in the oil tower and trigger the OWS to automatically pump the collected oil to a waste oil tank. The treated effluent can be tested for oil content by an oil content monitor. If the effluent contains higher than the desired oil content, it may be returned to the OWHT for further processing. If the oil and grease (HEM) content of the effluent is less than 15 ppm, the effluent may be discharged overboard.

The primary OWS system currently installed onboard WPB 110 Class vessels is one 2 gpm gravity coalescence type OWS to process bilgewater while underway. Additionally, WPB 110 Class vessels use one of two 120-gpm oily waste transfer pumps to offload oily waste and one 8-gpm waste oil transfer pump to offload waste oil to shore facilities. Gravity coalescers placed on Navy vessels are certified in accordance with NAVSEAINST 9593.2, OPNAVINST 5090.1B, and DoD Directive 6050.15. During normal pierside operation, WPB 110 Class vessel bilgewater is transferred to a shoreside treatment facility. The discharge duration is approximately 4.6 hours once every two days (Navy and EPA, 2003).

10.3.2.1 Discharge Characterization Data

Characterization data for the primary treatment discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) were assembled from surrogate data and supplemented by process knowledge from equipment experts and vendors. The Bilgewater ChAR (Navy and EPA, 2003) provides more information on the collection of discharge characterization data.

The data collection for this discharge identified 15 COCs, two classes of constituents, and seven narrative categories in the primary treatment discharge. Appendix B lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at EOMZ, and indicates whether they are elimination or reduction BCCs.

10.3.2.2 Discharge Comparison to Criteria

The composition of bilgewater is characterized by a set of constituent concentrations compiled from surrogate data, as described in the Bilgewater ChAR (Navy and EPA, 2003). In the comparison of constituent data for the primary treatment discharge to numeric WQC, the EOP concentrations of 14 constituents or constituent classes exceeded 93 WQC (Table 10-6). Appendix A summarizes the comparison of COC concentrations to the corresponding Federal and State numeric WQC. The primary treatment discharge also exceeded seven narrative WQC categories (Table 10-7). Appendix C provides the complete narrative WQC analysis.

Table 10-6. Constituents Exceeding Numeric Water Quality Criteria Identified in the Primary Treatment Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Constituents	Concentration at EOP (µg/L)	Criteria Exceeded	Strictest Criterion (µg/L)	State(s) with Strictest Criterion
Saltwater:				
Copper	1.5E+01	22 of 24	2.4E+00	CT, GA, MS
Iron	3.3E+02	1 of 1	3.0E+02	FL
Lead	9.8E+00	1 of 11	5.6E+00	FL
Manganese	1.1E+02	1 of 1	1.0E+02	PR
Nickel	1.1E+02	22 of 24	8.3E+00	FL, NC, PR
Thallium	1.2E+01	1 of 7	6.3E+00	FL
Zinc	4.5E+02	19 of 24	5.0E+01	PR
Phenanthrene	1.1E+01	3 of 3	5.0E+00	PA
Total Aqueous Hydrocarbons	7.7E+01	1 of 1	1.5E+01	AK
Total Aromatic Hydrocarbons	2.5E+01	1 of 1	1.0E+01	AK
Ammonia as Nitrogen	1.3E+03	1 of 2	2.3E+02	WA
Freshwater:				
Cadmium	2.4E+00	1 of 8	1.1E+00	FD
Copper	1.5E+01	12 of 14	8.8E+00	GA
Zinc	9.1E+01	7 of 14	6.4E+01	GA

Table 10-7. Narrative Water Quality Criteria Categories Exceeded by the Primary Treatment Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Narrative Constituent with Applicable Numeric Endpoint	Result
Saltwater:	
Color	Fail

Narrative Constituent with Applicable Numeric Endpoint	Result
Nutrients	Fail
Total Nitrogen (3.0E+02 μg/L)	3.0E+03 μg/L
Phosphorus (6.0E+01 μg/L)	1.5E+02 μg/L
Ammonia (1.0E+01 μg/L)	1.3E+03 μg/L
Nitrate/Nitrite (1.5E+01 μg/L)	3.4E+03 μg/L
Odor	Fail
Oil and Grease (HEM)	Fail
EOP (5.0E+03 μg/L)	2.2E+04 μg/L
No Sheen (1.5E+04 μg/L EOP)	2.2E+04 μg/L
Turbidity/Colloidal Matter	Fail
Freshwater:	
Hardness	Fail
Nutrients	Fail
Total Phosphorus (5.0E+01 μg/L)	1.5E+02 μg/L

10.3.2.3 Discharge Toxicity (Hazard Index)

Based on CH3D model results, the minimum dilution factor at the EOMZ for the primary treatment discharge was predicted to be 4795. This dilution factor was applied to the EOP concentration of the constituents to determine discharge toxicity at the EOMZ. The input parameters for this model run are presented in Appendix D, and the dilution graph, indicating the minimum dilution factor, is presented in Appendix E.

Table 10-8 summarizes the HQ and HI calculations for the constituents identified in the primary treatment discharge to have an HQ greater than 1 at the EOP. The constituents are listed from highest to lowest HQ at EOMZ.

Table 10-8. Constituents with Hazard Quotients > 1 at End of Pipe, Ranked by Edge of Mixing Zone Hazard Quotient, in the Primary Treatment Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Constituents	HQ at EOMZ
Total Sulfide	2.9E-02
Nitrate/Nitrite	1.0E-02
Copper	8.0E-03
Oil and Grease (HEM[1])	5.4E-03
Sulfate	3.2E-03
Zinc	1.0E-03
Thallium	4.0E-04
Nickel	3.2E-04
Iron	2.3E-04
Manganese	2.3E-04
HI of above constituents	5.8E-02
Total Discharge HI	**5.8E-02**

[1] *HEM TEC value was based on the fuel/lube TEC. For more information, see Development of TECs for Categories Derived from Petroleum and Foods (Navy and EPA, 2001g)*

The discharge HI at the EOMZ is 0.058, with the above constituents comprising approximately 99 percent of the total discharge HI.

10.3.2.4 Non-Indigenous Species Release

The potential for the baseline discharge to introduce NIS is expected to be low because *"there is only minor seawater access to bilge compartments, and bilgewater is generally processed before it is transported over long distances"* (EPA and DoD, 1999). The processing of the baseline bilgewater by a primary treatment MPCD will not increase, and may further reduce, the potential for the discharge to introduce NIS.

10.3.2.5 Bioaccumulative Contaminants of Concern

Table 10-9 lists the EOP concentrations of the seven constituents identified in the primary treatment discharge as elimination and reduction BCCs.

Table 10-9. Bioaccumulative Contaminants of Concern Identified in the Primary Treatment Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Elimination BCCs (µg/L)		Reduction BCCs (µg/L)	
Lead	9.8E+00	Zinc	4.5E+02
Cadmium	2.4E+00	Copper	1.8E+02
		Naphthalene	1.5E+01
		Phenanthrene	1.1E+01
		Selenium	7.1E+00

10.3.2.6 Constituent Mass Loading and Toxic Pound Equivalents

Table 10-10 summarizes the mass loading calculations and TPEs for the COCs identified in the bilgewater treated by primary treatment for this vessel group while operating inside 12 nm. The COCs are listed from highest to lowest TPE and comprise approximately 99 and 92 percent of the total discharge TPE of saltwater and freshwater respectively. Appendix F presents the complete discharge constituent mass loading and TPE data.

TPE results presented in Table 10-10 do not include the chronic toxicity contribution from oil and grease (HEM) constituents, because there are insufficient data available to develop a defensible TWF for oil and grease (HEM). The chronic toxicity contributions from oil and grease (HEM) constituents could potentially be estimated by extrapolation of HQ and HI results (refer to Section 10.3.2.3). The HI calculations indicate that oil and grease (HEM) constituents contribute nine percent of the total discharge HI, a measure of the total acute toxicity of bilgewater. Therefore, oil and grease (HEM) constituents are assumed to contribute nine percent of the total chronic toxicity for this analysis.

Table 10-10. Mass Loading and Toxic Pound Equivalents for the Constituents of Concern Identified in the Primary Treatment Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Saltwater:		
Total Sulfide	4.1E+01	1.2E+02
Copper	2.9E+00	5.2E+00
Nitrate/Nitrite	5.3E+01	4.9E+00
Nickel	1.8E+00	1.2E+00
Manganese	1.7E+00	1.0E+00
Zinc	7.0E+00	4.8E-01
Thallium	1.9E-01	1.7E-01
Ammonia as Nitrogen	2.0E+01	1.6E-01
Lead	1.5E-01	1.1E-01
Phenanthrene	1.7E-01	8.6E-02
Sulfate	7.7E+03	4.3E-02
Cadmium	3.7E-02	2.5E-02

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Naphthalene	2.3E-01	1.1E-02
Iron	5.1E+00	8.7E-03
Selenium	1.1E-01	8.8E-03
COC TPE Total		**1.3E+02**
Total Discharge TPE		**1.3E+02**
Freshwater:		
Total Sulfide	4.1E+00	1.1E+01
Nitrate/Nitrite	5.2E+00	4.8E-01
Copper	2.8E-01	1.8E-01
Zinc	6.9E-01	3.2E-02
Lead	1.5E-02	3.4E-02
Nickel	1.7E-01	1.9E-02
Thallium	1.8E-02	1.8E-02
Manganese	1.7E-01	1.2E-02
Selenium	1.1E-02	1.2E-02
Cadmium	3.6E-03	9.5E-03
Phenanthrene	1.7E-02	4.9E-03
Sulfate	7.6E+02	4.2E-03
Iron	5.0E-01	2.8E-03
Naphthalene	2.2E-02	3.4E-04
COC TPE Total		**1.2E+01**
Total Discharge TPE		**1.3E+01**

10.3.2.7 Other Potential Environmental Impacts

Primary treatment creates two waste streams: the aqueous fraction that is discharged overboard, and the oil fraction that is directed to the onboard waste oil holding tank. The environmental impacts of the aqueous fraction are evaluated above. The oil fraction is treated ashore at a properly permitted facility and subject to applicable Federal, State, and local disposal regulations.

10.3.2.8 Summary of Environmental Effects

The analysis of the primary treatment discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) identified 15 COCs, two constituent classes, and seven narrative categories. Appendix A lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at EOMZ, and indicates whether they are elimination or reduction BCCs. Appendix F presents the annual mass loading and TPE data for this discharge.

In summary, the primary treatment discharge:

- Exceeds 93 numeric WQC and seven narrative criteria categories;

- Has a discharge HI at EOMZ of 0.058;
- Has low potential to introduce NIS;
- Contains two elimination and five reduction BCCs; and
- Has a saltwater total discharge TPE inside 12 nm of 130, with the COCs comprising approximately 99 percent of the total and a freshwater total discharge TPE inside 12 nm of 13, with the COCs comprising approximately 92 percent.

10.3.3 Primary Treatment plus Filter Media (New Design Consideration Only)

For purposes of bilgewater analysis, gravity coalescence OWSs represent the three primary MPCD options for this vessel group (see Section 10.1). Secondary treatment options, such as the use of filter media, are therefore analyzed with gravity coalescence as a primary treatment. As discussed in the Bilgewater FIAR, filter media was deemed infeasible for use aboard existing vessels but potentially feasible for consideration on new design vessels. The following analysis is therefore for consideration of the filter media MPCD on new design vessels only.

As described in the *Draft Surface Vessel Bilgewater MPCD Screen-Control Device, MPCD Option Group: Filter Media* (Navy and EPA, 2001a), filter media are substances that selectively remove constituents (e.g., organics and metals) from wastewater. The media have an affinity for a particular constituent(s). When passed through the filter media, these constituents can be removed, typically through adsorption and/or absorption, from bilgewater. The types of media studied for this MPCD option group include activated carbon, polypropylene, resin bonded glass fiber, cellulose, humic acid, and synthetic polymers.

Primary treatment plus filter media is not currently practiced aboard vessels within this vessel group, in part because of space constraints.

10.3.3.1 Discharge Characterization Data

Baseline discharge characterization data for Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) were assembled from surrogate data and supplemented by process knowledge from equipment experts and vendors. The Bilgewater ChAR provides more information on the collection of discharge characterization data (Navy and EPA, 2003).

The data collection for this discharge identified 11 COCs, one class of constituents, and four narrative categories in the primary treatment plus filter media discharge. Appendix A lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at EOMZ, and indicates whether they are elimination or reduction BCCs.

10.3.3.2 Discharge Comparison to Criteria

The composition of bilgewater is characterized by a set of constituent concentrations compiled from surrogate data, as described in the Bilgewater ChAR (Navy and EPA, 2003). In the comparison of constituent data for primary treatment plus filter media discharge to numeric

WQC, the EOP concentrations of 11 COCs or constituent classes exceed 88 WQC (Table 10-11). Appendix A summarizes the comparison of the COC concentrations to corresponding Federal and State numeric WQC. The primary treatment plus filter media discharge also exceeded four narrative WQC categories (Table 10-12). Appendix C provides the complete narrative WQC analysis.

Table 10-11. Comparison of Constituent Concentrations Exceeding Numeric Water Quality Criteria for Primary Treatment plus Filter Media Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Constituents	Calculated Concentration at EOP (μg/L)[1]	Criteria Exceeded	Strictest Criterion (μg/L)	State(s) with Strictest Criterion
Saltwater:				
Copper	1.5E+01	22 of 24	2.4E+00	CT, GA, MS
Lead	9.8E+00	1 of 11	5.6E+00	FL
Manganese	1.1E+02	1 of 1	1.0E+02	PR
Nickel	8.4E+01	22 of 24	8.3E+00	FL, NC, PR
Thallium	1.2E+01	1 of 7	6.3E+00	FL
Zinc	2.7E+02	19 of 24	5.0E+01	PR
Total Aqueous Hydrocarbons	7.7E+01	1 of 1	1.5E+01	AK
Ammonia as Nitrogen	1.3E+03	1 of 2	2.3E+02	WA
Freshwater:				
Cadmium	2.4E+00	1 of 8	1.1E+00	FD
Copper	1.5E+01	12 of 14	8.8E+00	GA
Zinc	9.1E+01	7 of 14	6.4E+00	GA

[1] *Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

Table 10-12. Narrative Water Quality Criteria Categories Exceeded by the Primary Treatment plus Filter Media Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Narrative Constituent with Applicable Numeric Endpoint	Result
Saltwater:	
Nutrients	Fail
Total Nitrogen (3.0E+02 μg/L)	3.0E+03 μg/L
Phosphorus (6.0E+01 μg/L)	1.5E+02 μg/L
Ammonia (1.0E+01 μg/L)	1.3E+03 μg/L
Nitrate/Nitrite (1.5E+01μg/L)	2.0E+03 μg/L
Oil and Grease (HEM)	Fail
EOP (5.0E+03 μg/L)	6.5E+03 μg/L
No Sheen (1.5E+04 μg/L EOP)	6.5E+043μg/L
Freshwater:	
Hardness	Fail

Narrative Constituent with Applicable Numeric Endpoint	Result
Nutrients	Fail
Total Phosphorus (5.0E+01 μg/L)	1.5E+02 μg/L

10.3.3.3 Discharge Toxicity (Hazard Index)

Based on CH3D model results, the minimum dilution factor at the EOMZ for the primary treatment plus filter media discharge was predicted to be 4795. This dilution factor was applied to the EOP concentration of the constituents to determine discharge toxicity at the EOMZ. The input parameters for this model run are presented in Appendix D, and the dilution graph, indicating the minimum dilution factor, is presented in Appendix E.

Table 10-13 summarizes the HQ and HI calculations for constituents identified in the primary treatment plus filter media discharge that have an HQ greater than 1 at EOP. The constituents are listed from highest to lowest HQ at EOMZ.

Table 10-13. Constituents with Hazard Quotients > 1 at End of Pipe, Ranked by Edge of Mixing Zone Hazard Quotient, in the Primary Treatment plus Filter Media Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Constituents	HQ at EOMZ
Nitrate/Nitrite	6.0E-03
Sulfate	3.2E-03
Copper	4.0E-03
Thallium	2.5E-03
Oil and Grease (HEM[1])	1.6E-03
Zinc	6.2E-04
Nickel	2.4E-04
Manganese	2.3E-04
HI of above constituents	1.6E-02
Total Discharge HI	**1.7E-02**

[1] *HEM TEC value was based on the fuel/lube TEC. For more information, see* Development of TECs for Categories Derived from Petroleum and Foods *(Navy and EPA, 2001g)*

The discharge HI at EOMZ is 0.017, with the above constituents comprising 94 percent of the total HI.

10.3.3.4 Non-Indigenous Species Release

The potential for the baseline discharge to introduce NIS is expected to be low because *"there is only minor seawater access to bilge compartments, and bilgewater is generally processed before it is transported over long distances"* (EPA and DoD, 1999). As discussed in Section 10.3.2.4, the processing of the baseline bilgewater by a primary treatment OWS may reduce the potential for the discharge of NIS to the receiving waters. While WPB 110 vessels do not currently use a

secondary treatment device for bilgewater, the use of a secondary treatment option may further reduce the potential to release NIS.

10.3.3.5 Bioaccumulative Contaminants of Concern

Table 10-14 lists the EOP concentrations of the five constituents in the primary treatment plus filter media discharge identified as elimination and reduction BCCs.

Table 10-14. Bioaccumulative Contaminants of Concern Identified in the Primary Treatment plus Filter Media Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Elimination BCCs (µg/L)		Reduction BCCs (µg/L)	
Lead	9.8E+00	Zinc	2.7E+02
Cadmium	2.4E+00	Copper	9.2E+01
		Selenium	7.1E+00

10.3.3.6 Constituent Mass Loading and Toxic Pound Equivalents

Table 10-15 summarizes the mass loading and TPEs for the COCs identified in the primary treatment plus filter media discharge for this vessel group while operating inside 12 nm. The COCs are listed from highest to lowest TPE and comprise approximately 59 and 50 percent of the total discharge TPE of saltwater and freshwater respectively. Boron accounts for another 33 and 45 percent of the total discharge TPE of saltwater and freshwater respectively. Appendix F presents the complete discharge constituent mass loading and TPE data.

TPE results presented in Table 10-15 do not include the chronic toxicity contribution from oil and grease (HEM) constituents, because there are insufficient data available to develop a defensible TWF for oil and grease (HEM). The chronic toxicity contributions from oil and grease (HEM) constituents could potentially be estimated by extrapolation of HQ and HI results (refer to Section 10.3.3.3). The HI calculations indicate that oil and grease (HEM) constituents contribute approximately ten percent of the total discharge HI, a measure of the total acute toxicity of bilgewater. Therefore, oil and grease (HEM) constituents are assumed to contribute approximately ten percent of the total chronic toxicity for this analysis.

Table 10-15. Mass Loading and Toxic Pound Equivalents for the Constituents of Concern Identified in the Primary Treatment plus Filter Media Discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Saltwater:		
Nitrate/Nitrite	3.2E+01	2.9E+00
Copper	1.4E+00	2.6E+00
Manganese	1.7E+00	1.0E+00
Nickel	1.3E+00	9.0E-01
Zinc	4.2E+00	2.9E-01

Discharge Constituent	Mass Loading (lb/yr)	Toxic Pound Equivalents
Thallium	1.9E-01	1.7E-01
Ammonia as Nitrogen	2.0E+01	1.6E-01
Lead	1.5E-01	1.1E-01
Sulfate	7.7E+03	4.3E-02
Cadmium	3.7E-02	2.5E-02
Selenium	1.1E-01	8.8E-03
COC TPE Total		**8.3E+00**
Total Discharge TPE		**1.4E+01**
Freshwater:		
Nitrate/Nitrite	3.1E+00	2.9E-01
Copper	1.4E-01	8.9E-02
Lead	1.5E-02	3.4E-02
Zinc	4.1E-01	1.9E-02
Thallium	1.8E-02	1.8E-02
Nickel	1.3E-01	1.4E-02
Manganese	1.7E-01	1.2E-02
Selenium	1.1E-02	1.2E-02
Cadmium	3.6E-03	9.5E-03
Sulfate	7.6E+02	4.2E-03
COC TPE Total		**5.0E-01**
Total Discharge TPE		**1.0E+00**

10.3.3.7 Other Potential Environmental Impacts

Primary treatment plus filter media creates three waste streams: the aqueous fraction that is discharged overboard following treatment, the oil fraction that is directed to the vessel's waste oil holding tank, and the solid waste composed of used filters. The environmental impacts of the aqueous fraction are evaluated above; there are no other known impacts to the receiving environment. The oil fraction is treated at a properly permitted facility and the used filters are subject to applicable Federal, State, and local disposal regulations.

10.3.3.8 Summary of Environmental Effects

The analysis of the primary treatment plus filter media discharge from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) identified 11 COCs, one constituent class, and four narrative categories. Appendix A lists the EOP concentrations of the COCs, their corresponding acute WQC, HQs at EOMZ, and indicates whether they are elimination or reduction BCCs. Appendix F presents the annual mass loading and TPE data for this discharge.

In summary, the primary treatment plus filter media discharge:

- Exceeds 88 numeric WQC and four narrative criteria categories;

- Has a discharge HI at EOMZ of 0.017;
- Has low potential to introduce NIS;
- Contains two elimination and three reduction BCCs; and
- Has a saltwater total discharge TPE inside 12 nm of 14, with the COCs comprising approximately 59 percent of the total and a freshwater total discharge TPE inside 12 nm of 1.0, with the COCs comprising approximately 50 percent.

10.3.4 Collection, Holding, and Transfer (CHT)

Collection, holding, and subsequent transfer of bilgewater involves either shore disposal facilities or waste offload barges, or processing of bilgewater beyond 12 nm. Shore disposal involves transfer of wastes to properly permitted treatment facilities either directly through a shoreside piping connection, or via tank trucks or waste offload barges. CHT does not include any treatment or volume reduction of raw bilgewater on board the vessel. In a typical CHT system, wastewater drains to the bilge or is transferred to a designated holding tank where it is retained until either the vessel returns to port or transits beyond 12 nm.

CHT is in use, to some extent, on all vessels that generate bilgewater, including the WPB 110 Class. All WPB 110 Class vessels have OWS systems and use them to treat the discharge, when CHT is not being practiced. While moored pierside in ports where shore facilities are available, WPB 110 Class vessels practice CHT by transferring bilgewater to a properly permitted shoreside facility. If shore facilities are unavailable, or the vessel is operating outside 12 nm, bilgewater is processed through an OWS and then discharged (See Section 10.3.2 on primary treatment OWS). Additional information on this MPCD is provided in the *Surface Vessel Bilgewater MPCD Screen-Control Device, MPCD Option Group: Collection, Holding, and Transfer* (Navy and EPA, 2001c).

10.3.4.1 Discharge Characterization Data

CHT does not directly release wastewater to the receiving waters within 12 nm. Refer to the Bilgewater ChAR for more information on the collection of characterization data (Navy and EPA, 2003).

10.3.4.2 Discharge Comparison to Criteria

Because CHT does not directly release wastewater to the receiving waters within 12 nm, no numeric or narrative WQC are exceeded in the receiving waters.

10.3.4.3 Discharge Toxicity (Hazard Index)

Because CHT does not directly release wastewater to the receiving waters within 12 nm, there is no liquid discharge to model, nor an HI to calculate at the EOMZ.

10.3.4.4 Non-Indigenous Species Release

Because CHT does not directly release wastewater to the receiving waters within 12 nm, the potential for the discharge to release NIS is nearly nonexistent.

10.3.4.5 Bioaccumulative Contaminants of Concern

Because CHT does not directly release wastewater to the receiving waters within 12 nm, essentially no BCCs are released.

10.3.4.6 Constituent Mass Loading and Toxic Pound Equivalents

Because CHT does not directly release wastewater to the receiving waters within 12 nm, this MPCD option has essentially no mass loading of constituents to the receiving waters; therefore, no TPEs were calculated.

10.3.4.7 Other Potential Environmental Impacts

The only potential direct impact identified for this MPCD within 12 nm would result from the mishandling of the collected bilgewater during the offloading and transfer to shore for disposal. The transferred bilgewater is treated at a properly permitted facility.

10.4 MPCD RANKING AND ASSOCIATED UNCERTAINTY

This section analyzes and ranks each MPCD option that passed the MPCD screen and was not determined to be infeasible in the Bilgewater FIAR (Navy and EPA 2002c) for Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement). Included in this section is a discussion of uncertainty and its effect on the ranking of MPCDs.

The primary-treatment MPCD options for bilgewater in Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) are gravity coalescence, centrifuge, and hydrocyclone. For simplification, these MPCDs were combined and represented by gravity coalescence, as described in the Bilgewater ChAR (Navy and EPA, 2003). CHT is also a primary MPCD option for bilgewater. Filter media is a secondary-treatment MPCD option that can be used in conjunction with the gravity coalescence, centrifuge, or hydrocyclone MPCD options. As with primary treatment, secondary treatment options are represented in UNDS analysis by being combined with gravity coalescence. The term “treatment train” is used when describing combinations of primary and secondary treatment MPCD options.

To analyze the environmental effectiveness of a particular MPCD option or MPCD treatment train, the results of the environmental analysis were compared to:

- Number of exceeded WQC;
- Number of constituents exceeding the strictest criteria;
- HI toxicity analysis;
- Presence of BCCs;
- Constituent mass loading and TPEs;

- Potential to introduce NIS; and
- Other environmental effects.

10.4.1 Exceeded Water Quality Criteria

As discussed in the Bilgewater ChAR (Navy and EPA, 2003), there is wide variability in the composition of bilgewater. This variability is due to many factors, including variation in constituent sources (e.g., the occurrence of mechanical leakage), variation in processing rates, age of vessel and piping materials, and variations in equipment reliability. Due to these many factors, sampling was conducted only to take a "snapshot" of the bilgewater composition for the discharge to complement available process knowledge. Uncertainty due to naturally occurring variability is the primary impediment of using sample data to rank MPCD options. Therefore process knowledge is the primary source of information for this ranking.

In addition to variability, questions of data accuracy contribute to uncertainty. The primary uncertainty associated with the WPB 110 Class vessel group data accuracy is due to the lack of sampling data from the representative vessel or any other vessel within the vessel group. Sample data used to characterize this vessel group were taken from UNDS Phase II sampling results for the LSD 41 vessel class. The LSD 41 was used to represent the WPB 110 vessel group because the engine types for the WPB 110 and LSD 41 classes are similar. In addition, process knowledge indicated the sources of bilgewater constituents were similar (Navy and EPA, 2001d). One important source of accuracy is in regard to the data used to describe primary treatment plus filter media. As discussed in the Bilgewater ChAR (Navy and EPA, 2003), the data used to describe filter media performance are based on favorable conditions and therefore may not represent a long-term average.

Table 10-16 provides a comparison of constituent concentrations to WQC values for those constituents that exceed the strictest criterion.

Table 10-16. Comparison of Discharge Constituent Concentrations (µg/L) that Exceed Numeric Water Quality Criteria in the Baseline Discharge and MPCD Discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Strictest WQC	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT[2]
Saltwater:					
Copper	2.4E+00	1.3E+01	1.5E+01	1.5E+01	0
Iron	3.0E+02	3.4E+02	3.3E+02	1.3E+02[3]	0
Lead	5.6E+00	8.9E+00	9.8E+00	9.8E+00	0
Manganese	1.0E+02	1.1E+02	1.1E+02	1.1E+02	0
Nickel	8.3E+00	1.1E+02	1.1E+02	8.4E+01	0
Thallium	6.3E+00	1.5E+01	1.2E+01	1.2E+01	0
Zinc	5.0E+01	4.1E+02	4.5E+02	2.7E+02	0
Phenanthrene	5.0E+00	1.1E+01	1.1E+01	ND	0
Total Aqueous Hydrocarbons	1.5E+01	7.4E+01	7.7E+01	7.7E+01	0

Discharge Constituent	Strictest WQC	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT[2]
Total Aromatic Hydrocarbons	1.0E+01	2.4E+01	2.5E+01	ND	0
Ammonia as Nitrogen	2.3E+02	1.2E+03	1.3E+03	1.3E+03	0
Freshwater:					
Cadmium	1.1E+00	2.3E+00	2.4E+00	2.4E+00	0
Copper	8.8E+00	1.3E+01	1.5E+01	1.5E+01	0
Zinc	6.4E+01	9.8E+01	9.1E+01	9.1E+01	0
Number of Constituents exceeding strictest WQC	**-**	**14**	**14**	**11**	**0**
Total Exceeded Numeric Criteria	**-**	**96**	**93**	**88**	**0**

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*
[2] *CHT does not release constituents to the receiving waters.*
[3] *Value does not exceed criteria.*
ND = Not detected

Surrogate data do not suggest a substantial reduction in the number of constituents exceeding criteria, or the total number of criteria exceeded, after primary treatment. Although process knowledge indicates that the gravity coalescence will provide a reduction in certain constituent concentrations, this reduction is not realized in the total criteria exceedance count because the primary source of toxicity in this discharge is from metals. The treatment technologies evaluated in this analysis were designed to remove petroleum hydrocarbons rather than metals, although some reduction may be achieved. The exceedance counts, as one measure of environmental effect, support the following rankings.

MPCD ranking by numeric WQC exceeded:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only

Table 10-17 provides a comparison of baseline and MPCD option characteristics to narrative WQC.

Table 10-17. Comparison of Narrative Water Quality Criteria for Baseline and MPCD Discharge Constituents for Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Narrative Constituent with Applicable Numeric Endpoint	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT
Saltwater:				
BOD	Pass	Pass	Pass	Pass
Color	Fail	Fail	Pass	Pass
Floating Material	Pass	Pass	Pass	Pass
Nutrients	Fail	Fail	Fail	Pass
Odor	Fail	Fail	Pass	Pass

Narrative Constituent with Applicable Numeric Endpoint	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT
Oil and Grease (HEM)	Fail	Fail	Fail	Pass
Pathogens	Pass	Pass	Pass	Pass
Settleable Materials	Pass	Pass	Pass	Pass
Suspended Solids	Pass	Pass	Pass	Pass
Taste	Pass	Pass	Pass	Pass
Temperature	Pass	Pass	Pass	Pass
Turbidity/Colloidal Matter	Fail	Fail	Pass	Pass
Freshwater:				
Alkalinity	Pass	Pass	Pass	Pass
Hardness	Fail	Fail	Fail	Pass
Nutrients	Fail	Fail	Fail	Pass
Oil and Grease (HEM)	Fail	Pass	Pass	Pass
Pathogens	Pass	Pass	Pass	Pass
pH	Pass	Pass	Pass	Pass
Specific Conductance	Pass	Pass	Pass	Pass
Total Dissolved Solids	Pass	Pass	Pass	Pass
Total Exceeded Narrative Categories	**8**	**7**	**4**	**0**

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

MPCD ranking by narrative criteria involve less uncertainty than HI, TPE, and criteria exceedances because they rely less on constituent concentrations averaged over a few sampling events and more on process knowledge.

MPCD ranking by narrative WQC exceeded:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment.

10.4.2 Discharge Hazard Index

The UNDS program incorporates an HI approach as a means of estimating the aggregate toxicity of a discharge. This estimate is made by first applying a modeled dilution factor to EOP constituent surrogate data. The HQs are determined by dividing the product by the constituent-specific toxicological endpoint concentration (TEC). The HI is the summation of these quotients, which is used to estimate acute marine aquatic-life toxicity at the EOMZ. This analysis method is described in the EEA guidance manual (Navy and EPA, 2000e). For more information on the HI method, see the *Method for Assessing the Toxicity of Multiple Contaminants in Discharges from Vessels of the Armed Forces Uniform National Discharge Standards* (Navy and EPA, 2001f).

The uncertainty of HI values is primarily based on the uncertainty in surrogate data, compounded by approximations made in the computer-based modeling of the liquid discharge. For more information about the UNDS modeling method, see the *Technical Approach for Pierside Modeling to Support UNDS EEA Phase II* (Navy and EPA, 2001e).

Table 10-18 provides the calculated HI values for the baseline discharge and MPCD options as well as the EOP HQs for the COC.

Table 10-18. Comparison of Constituent on Concern Hazard Quotients and Total Discharge Hazard Indices at Edge of Mixing Zone in Baseline and MPCD Discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT
Ammonia as Nitrogen	4.6E-05	4.8E-05	4.8E-05	0
Cadmium	1.2E-05	1.2E-05	1.2E-05	0
Copper	8.7E-03	8.0E-03	4.0E-03	0
Iron	2.4E-04	2.3E-04	9.1E-05	0
Lead	8.8E-06	9.7E-06	9.7E-06	0
Manganese	2.2E-04	2.3E-04	2.3E-04	0
Nickel	3.2E-04	3.2E-04	2.4E-04	0
Nitrate/Nitrite	8.8E-03	1.0E-02	6.0E-03	0
Selenium	5.2E-06	5.1E-06	5.1E-06	0
Sulfate	3.3E-03	3.2E-03	3.2E-03	0
Thallium	5.1E-04	4.0E-04	4.0E-04	0
Total Sulfide	3.3E-02	2.9E-02	ND	0
Zinc	9.5E-04	1.0E-03	6.2E-04	0
Oil and Grease (HEM[2])	6.8E-03	5.4E-03	1.6E-03	0
Total Discharge HI	**6.3E-02**	**5.8E-02**	**1.7E-02**	**0**

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

[2] *HEM TEC value was based on the fuel/lube TEC. For more information, see* Development of TECs for Categories Derived from Petroleum and Foods *(Navy and EPA, 2001g).*

ND = Not Detected

Because CHT does not result in the direct discharge from the ship within 12 nm (i.e. HI = 0 for CHT), analysis supports the following rankings, independent of data uncertainty.

MPCD ranking by discharge HI:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only

10.4.3 Non-Indigenous species

CHT has essentially no potential to release NIS because there is no direct discharge to the receiving waters. The potential for the primary treatment discharge to introduce NIS is expected to be low because *"there is only minor seawater access to bilge compartments, and bilgewater is generally processed before it is transported over long distances"* (EPA and DoD, 1999). The filter media may provide an additional protection against release of NIS.

MPCD ranking by potential to release NIS:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only

10.4.4 Bioaccumulative Contaminants of Concern

Table 10-19 provides a comparison of the number of elimination and reduction BCCs identified in the discharge across MPCDs. BCCs in the discharges are also indicated by an asterisk (*) in Appendices A and B.

Table 10-19. Comparison of Bioaccumulative Contaminants of Concern Identified in Baseline and MPCD Discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge	Elimination BCCs	Reduction BCCs	Total BCCs
Collection, Holding, and Transfer (CHT)	0	0	0
Primary Treatment plus Filter Media[1]	2	3	5
Primary Treatment	2	5	7
Baseline discharge	2	5	7

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

Uncertainty in the ranking of MPCD options by BCC count is due to the same factors identified in Section 10.4.1. The primary source of uncertainty is naturally occurring variability.

MPCD ranking by presence of BCCs:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only

10.4.5 Constituent Mass Loading and Toxic Pound Equivalents

As discussed in the EEA guidance manual (Navy and EPA, 2000e), mass loading and TPEs were calculated for each discharge constituent. Both the mass loading and TPE calculations are functions of the constituent concentrations and annual discharge volumes. The uncertainty

associated with the constituent concentration values is due to the naturally occurring variability in bilgewater composition, as described in Section 10.4.1.

As discussed in the Bilgewater ChAR (Navy and EPA, 2003), the UNDS Phase I Surface Vessel Bilgewater/OWS Nature of Discharge report (NOD) estimates that the average in-port generation rate for a WPB class vessel is approximately 2,000 gal/day (EPA and DoD, 1999). However, actual performance data indicates the generation is 4 gal/day in port and 25 gal/day underway (Navy, 1995). Additionally, the more than 60 vessel classes that comprise this vessel group vary in vessel size, machinery, and displacement. Unlike other discharges, the bilgewater generation rates do not depend on crew size, but rather ship size and propulsion plant type. As a result, having multiple vessel classes results in more variation in generation rates and these variations reflect the uncertainty associated with these values.

For more information about the uncertainty associated with the generation rates, see the Bilgewater ChAR (Navy and EPA, 2003). The ChAR provides details on the assumptions made to determine the generation rate; specifically, that all of the bilgewater generated pierside is discharged overboard. In practice, however, bilgewater generated by the WPB 110 Class vessels is typically treated at a shoreside facility.

Mass loading data for the baseline discharge and each MPCD option are summarized in Table 10-20.

Table 10-20. Comparison of Discharge Constituents of Concern Mass Loading (lbs/yr) in Baseline and MPCD Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge Constituent	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT[2]
Saltwater:				
Ammonia as Nitrogen	1.9E+01	2.0E+01	2.0E+01	0
Cadmium	3.6E-02	3.7E-02	3.7E-02	0
Copper	3.1E+00	2.9E+00	1.4E+00	0
Iron	5.3E+00	5.1E+00	ND	0
Lead	1.4E-01	1.5E-01	1.5E-01	0
Manganese	1.7E+00	1.7E+00	1.7E+00	0
Naphthalene	2.1E-01	2.3E-01	ND	0
Nickel	1.8E+00	1.8E+00	1.3E+00	0
Nitrate/Nitrite	4.6E+01	5.3E+01	3.2E+01	0
Phenanthrene	1.8E-01	1.7E-01	ND	0
Selenium	1.1E-01	1.1E-01	1.1E-01	0
Sulfate	7.8E+03	7.7E+03	7.7E+03	0
Thallium	2.4E-01	1.9E-01	1.9E-01	0
Total Sulfide	4.7E+01	4.1E+01	ND	0
Zinc	6.4E+00	7.0E+00	4.2E+00	0

Discharge Constituent	Baseline	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT[2]
Freshwater:				
Cadmium	3.6E-03	3.6E-03	3.6E-03	0
Copper	3.1E-01	2.8E-01	1.4E-01	0
Iron	5.2E-01	5.0E-01	ND	0
Lead	1.4E-02	1.5E-02	1.5E-02	0
Manganese	1.7E-01	1.7E-01	1.7E-01	0
Naphthalene	2.0E-02	2.2E-02	ND	0
Nickel	1.7E-01	1.7E-01	1.3E-01	0
Nitrate/Nitrite	4.5E+00	5.2E+00	3.1E+00	0
Phenanthrene	1.7E-02	1.7E-02	ND	0
Selenium	1.1E-02	1.1E-02	1.1E-02	0
Sulfate	7.7E+02	7.6E+02	7.6E+02	0
Thallium	2.4E-02	1.8E-02	1.8E-02	0
Total Sulfide	4.6E+00	4.1E+00	ND	0
Zinc	6.3E-01	6.9E-01	4.1E-01	0

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

[2] *CHT does not release constituents to the receiving waters.*

ND = Not Detected

MPCD options were not ranked by mass loading values because they would have to be ranked for every constituent separately. In order to capture the net chronic toxic effect of each constituent's mass loading the relative toxicity of each constituent would have to be weighted. In order to achieve a relative ranking, TPEs were utilized. Table 10-21 provides the TPEs for the baseline discharge and MPCD options for this vessel group.

Table 10-21. Comparison of Toxic Pound Equivalents for the Baseline Discharge and MPCD Discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

Discharge	Toxic Pound Equivalent
Saltwater	
Collection, Holding, and Transfer (CHT)	0
Baseline Discharge	1.5E+02
Primary Treatment	1.3E+02
Primary Treatment plus Filter Media[1]	1.4E+01
Freshwater	
Collection, Holding, and Transfer (CHT)	0
Baseline Discharge	1.4E+01
Primary Treatment	1.3E+01
Primary Treatment plus Filter Media[1]	1.0E+00

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

The total discharge TPE does not include the chronic toxicity contribution from oil and grease (HEM) constituents, however, because the individual constituents of this fraction vary by products entering the bilge and the degree of product weathering before discharge. The chronic toxicity contributions were therefore evaluated by comparing to HQ and HI results. As discussed in Sections 10.3.1.6, 10.3.2.6, and 10.3.3.6, oil and grease (HEM) constituents are assumed to contribute up to 11 percent of total chronic toxicity in discharges, based on acute toxicity (HI) determinations.

Overall, TPE calculations for the baseline and MPCD options indicate that primary treatment provided a minor reduction in equivalent toxic mass discharged. The addition of the filter media secondary treatment option was shown to reduce the TPE by approximately 91 and 93 percent compared with the baseline discharge for saltwater and freshwater respectively.

MPCD ranking by TPE:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only

10.4.6 Other Potential Environmental Impacts

Most MPCDs create two waste streams: the aqueous fraction that is discharged overboard following treatment and the oil fraction that is directed to the on-board waste-oil holding tank. The oil fraction is treated at a properly permitted facility and subject to applicable Federal, State, and local disposal regulations. The use of filter media creates an additional waste in the form of used filters. Disposal of these used components is subject to Federal, State, and local disposal regulations. For purposes of this analysis, the disposal of these discharges is assumed to comply

with applicable regulations. The MPCD options described in this analysis of bilgewater are therefore ranked as equivalent options in terms of other environmental impacts.

10.4.7 Conclusion

The results of the EEA for the baseline and MPCD bilgewater discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) are summarized in Table 10-22

Table 10-22. Summary of EEA for Baseline and MPCD Bilgewater Discharges from Small Compression Ignition Ships (65 feet or more in length and under 400 tons of displacement) (WPB 110 Based on LSD 41 Surrogate Data)

	Baseline Bilgewater	Primary Treatment	Primary Treatment Plus Filter Media[1]	CHT
Number of Constituents exceeding strictest WQC	14	14	11	0
Total Number of Exceeded Numeric WQC	96	93	88	0
Number of Exceeded Narrative Categories	8	7	4	0
Discharge HI at EOMZ	6.3E-02	5.8E-02	1.7E-02	0
Potential for NIS Release	Low	Low	Low	None
Number of BCCs Identified	7	7	5	0
Discharge TPE (Saltwater)	1.5E+02	1.3E+02	1.4E+01	0
Discharge TPE (Freshwater)	1.4E+01	1.3E+01	1.0E+00	0

[1] *For new design consideration only. Constituent concentrations are calculated using methodology described in Putnam and Singerman (2001).*

In summary, the application of CHT to bilgewater has the least environmental impact because there is no direct discharge to the receiving water. Primary treatment is expected to result in fewer deleterious environmental effects than the baseline discharge.

MPCD ranking by overall environmental effect:

1. CHT
2. Primary treatment plus filter media (for new design consideration only)
3. Primary treatment only